Value Management

BTeV Document # 3578

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Assembled by T. Lackowski

VALUE MANAGEMENT

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PROJECT DESCRIPTION AND BACKGROUND

The BTeV Project

The purpose of the BTeV Project is to design, construct, and install the BTeV detector, interaction region, and supporting experimental facilities needed to achieve the physics goals set out in the BTeV Proposal Update of April 2002. Beginning in CY 1998, an effort has been underway to carry out conceptual design activities and R&D to be able to construct this detector. This has resulted in a detailed technical design, described in the BTeV Detector Technical Design Report. Parallel efforts to design and specify the components of the Interaction Region, usually referred to as the "IR", and develop a conceptual design began in 2000. At the same time a project was initiated to design and specify the changes that need to be made in and around the C0 interaction region of the collider to support the BTeV experiment. This activity is referred to as the "C0 Outfitting' (sub)project. The implementation of all three of these components, BTeV detector, C0 Interaction Region and C0 Outfitting is referred to as the "BTeV Project" and is the subject of this Value Management report.

The principal elements of the BTeV Detector sub-project are:

1.1 Modification and installation of an existing analysis magnet, construction of two toroids (using existing steel), and construction of beam pipes that provide the physical infrastructure of BTeV experiment;
1.2 Construction of a silicon pixel vertex detector to reconstruct primary interaction vertices and secondary decay vertices and which can be used in the lowest level trigger of the experiment;
1.3 Construction of a Ring Imaging Cherenkov counter (RICH) to provide charged hadron identification;
1.4 Construction of a high resolution, highly segmented electromagnetic calorimeter to reconstruct photons and π^0's;
1.5 Construction of a muon detector that can also be used in a stand-alone lowest level trigger;
1.6 Building of a forward tracker based on straw detector technology that covers large angles with respect to the beam and provides tracking in the downstream part of the detector and improves the momentum measurement obtained from the pixel detector alone;
1.7 Building of a forward tracker based on silicon microstrip technology that covers small angles with respect to the beam to provide tracking in the downstream part of the detector;
1.8 Construction of a three level trigger system, including all hardware and software, which is highly efficient for a large variety of bottom and charm decays and achieves excellent rejection of light-quark events;
1.9 Building of a data acquisition system and all necessary interfacing electronics and software to record all events containing a wide variety of bottom and charm decays; and
1.10 Installation in the C0 collision hall, alignment, integration, debugging, and technical commissioning (described below) for all components.

The principal elements of the C0 Interaction Region subproject are:

2.0 Construction of a straight section for parasitic testing of BTeV detector components as they are completed, and installation of the C0 Interaction region to produce high luminosity, 1 to $2x10^{32}/cm^2$-s, which will enable BTeV to achieve its design sensitivity. This requires the design of a low-beta insertion to have collisions at high luminosity in the C0 Interaction Region, to construct the components to implement the design, and to install and commission the components.

The principal elements of the C0 Outfitting subproject are:

3.0 Construction of the architectural finishes, mezzanine structures, heating, ventilation, air conditioning (HVAC), process piping systems, and power to support the BTeV detector and upgrade of the C0 Service Building, including architectural modification, HVAC and power to support the Interaction Region at C0.

VALUE MANAGEMENT

BTeV VM PROGRAM SUMMARY

Value Management (VM) utilizes the total resources available to the BTeV organization to achieve broad, top management objectives. VM is an integral part of the overall project delivery process and is not a separate entity. VM is a systematic and creative approach for increasing the "return on investment" in components, systems, facilities, and other products required for BTeV. Increased return on investment for BTeV and DOE results with the lower cost for the acquisition of systems, equipment, facilities, services, and supplies, while maintaining the required level of performance. Value Management has been accomplished in many of the BTeV Detector, C0 Interaction Region and C-0 Occupancy sub-projects. The function of this document is to collect and record the various Value Management efforts to date. This document will be updated to incorporate additional Value Management proposals as they are developed.

The Level two and Level three managers are responsible for promoting and performing Value Management at all stages of the design. Task groups or internal design review provide the stage for the Value Management process. Collaboration meetings and Tech board meetings are the setting for analysis of VM proposals. The set points that determine the required level of approval is that which is described in the Project Management Plan (PMP) for change control. All change control provisions are to be strictly adhered to prior to implementing a VE proposal starting with project baseline approval. The sub-projects studies use the Corps of Engineers standard Value Management methodology, consisting of five phases:

Information Phase: Sub-project teams study criteria, drawings, figures, descriptions of project work, schedules and cost estimates to fully understand the work to be performed and the functions to be achieved. Cost Estimates are compared to determine areas of relative high cost to ensure that focus is on those parts of the project that offer the most potential for cost savings.

Speculation Phase: The Sub-project team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas is discouraged.

Analysis Phase: Evaluation, testing and critical analysis of all ideas generated during speculation are performed to determine potential for savings and possibilities for risk. Initial costs as well as life cycle costs are considered. Ideas are ranked by priority for development. Ideas which do not survive critical analysis are deleted.

Value Management Proposal: Ideas are developed into written proposals by Level 2 or Level 3 managers. Proposal descriptions, along with sketches, technical support documentation, and cost estimates are prepared to support implementation of ideas.

Value Management Presentation: Proposals are presented to the sub-project team and incorporated into the work if minor in nature and the effects are self-contained within the sub-project. Proposals that affect the baseline or multiple sub-projects are presented to the Tech Board, the BTeV Collaboration or both. Change control is enacted whenever required.

BTeV Project Organization, Methods of Value Management

The BTeV project and collaboration has, from its inception, followed best management practices. Striving to achieve the core objectives of Value Management has always been a consistent goal of project and subproject management. The projects process that was used to develop the various detectors and subprojects mimics the Value Management process. The proposal description for the Pixel detector, WBS 1.2, demonstrates how the process has been followed for that sub-project. Particulars of the Value Management process used in the various sub-projects differ slightly but follows the overall process described.

Training

Training Level 2 and / or Level 3 sub-project managers in the Value Management process and methodologies has been accomplished by the distribution and discussion of the U.S. Department of Energy, Office of Management, Budget and Evaluation, Value Management, Rev. E, dated June 2003. Additional training has occurred at collaboration and Tech. Board meetings.

VALUE ENGINEERING PROPOSALS

PROPOSAL BTeV Pixel Detector Sub-Project **WBS:** 1.2
LEVEL 2 MANAGER: Simon Kwan

DESCRIPTION: Introduction and History

Value engineering has been the normal practice in developing the pixel detector for BTeV. Examples of value engineering decisions which have been made for the pixel detector include

1. Pixel vs. strip as basic vertex detector concept
2. Deep submicron vs. military process for readout chips
3. P-spray vs. p-stop isolation on the sensors
4. Fuzzy carbon vs. Thermal Pyrolytic Graphite substrate support
5. LN2 cooling vs. water/glycol or any active coolant
6. Piezo electric actuators vs. pneumatic or hydraulic driven ones
7. Titanium sublimation pumps vs. liquid helium cryo pumps in vacuum system

The methodology used for these decisions passes through the following phases (taken from guidance on Value Management from the Corps of Engineers):

1. Information Phase

This phase was dominated by the development of the specifications for the pixel detector. These specifications were developed by the subproject team, using simulation studies to determine the impact on the physics reach and goals of the experiment.

The performance specifications can be found in the BTeV Document Database.

2. Speculation Phase

A first pixel system design was developed and reported upon in presentations to the full BTeV collaboration and to the wider community of detector builders and physicists at conferences and publications. A list of these publications is available on the web at

http://www-btev.fnal.gov/public/hep/detector/pixel/status/pixel_papers.shtml

3. Analysis Phase

Value engineering was performed by comparing engineering solutions to the initial design, including considerations of cost, buildability, reliability, and effect on the physics goals of the experiment.

Those parts of the project with the longest lead times and greatest risk received earliest attention. These included the development of sensors and readout chips. Later, attention was focused on the support structure, cooling, and vacuum systems for the pixel detector.

4. Value Management Proposal

Significant changes to the initial system design were incorporated only after extensive discussions in the regular Pixel Group meetings (by-weekly) and Pixel Mechanical Group meetings (alternate weeks).

5. Value Management Presentation

Tests of components to see that they met (or where they failed to meet) specified performance included bench tests of prototypes, irradiation tests, and beam tests.

Presentations of the results of these tests were presented at the same meetings discussed above and reported to the collaboration and in conferences and publications. The presentations are available in the BTeV Document Database and among the listed publications at the web site above.

Final acceptance of significant changes from the baseline detector system (defined by the Preliminary Technical Design Report – BTeV Document BTeV-doc-32-v2, Preliminary TDR, 26 Mar 2003) are made only after presentation to and approval by the BTeV Technical Board.

This process has been followed for the change to the substrate design and the cooling system.

Continuing Value Engineering Management

The first five issues above have been resolved and taken through the above value engineering management, and are now part of the pixel detector system for BTeV, ready for base lining by the Department of Energy.

As examples, here are representative samples of documentation of the value engineering process for two of the above engineering issues:

1. Fuzzy carbon vs. TPG
   DESCRIPTION: Pixel station substrate design, material choice and cooling design.

ORIGINAL DESIGN: Fuzzy carbon with embedded glassy carbon cooling tubes.

PROPOSED DESIGN: TPG substrates using conductive cooling path to LN2 cold blocks.

ADVANTAGES: Simplified mechanical and cooling design. Integration of cooling system with cryogenic vacuum system. Utilization of materials known to be able to be manufactured in the required quantities (reduced technical, cost and schedule risk).

DISADVANTAGES: Major redesign of the pixel mechanical and cooling systems, materials testing and certification and systems testing are required. Much of this work remained to be done for the original design so it is not a large incremental effort. The pixel power (~3kW) is removed at 77K rather than ~250K reducing the efficiency of the cooling system. This has limited impact on the total cost for deployment plus operational costs over the life of the experiment.

JUSTIFICATION: The original design featured a large number for cooling channels containing water-based fluids inside the vacuum of the TeVatron. These glassy carbon tubes were felt to have an unacceptable probability of failure that could lead to a water to vacuum leak. In addition it was not clear that the (only) vendor could deliver the substrates within a reasonable cost and schedule. The new design uses materials that have been mass-produced for other detector systems, notably ATLAS, and contains no liquid to vacuum joints. It also takes advantage of existing infrastructure within the pixel tank, required for the vacuum system, as a sink to cool the pixels, completely eliminating the independent cooling system required in the original design.

List of documents:

- Substrate RD after Temple (doc-1356)
- Advancing the discussion of support/cooling approaches (doc 1368)
- Pixel detector support and cooling options worksheet (doc 1381)
- A development plan for a TPG/Cold-finger Pixel Substrate (doc 1367)
- Update on Pixel TPG substrate development (doc 1415)
- Change to TPG substrate (doc 1708 - Presentation to Technical Board, April 2003)

Cost Estimate:

Fuzzy carbon about $500K

TPG substrate and post-delivery machining: $300K

Status: Presented to PAC, Spring 2003 and approved by Technical Board April 2003

2. Cooling

Substrate Cooling using controlled flow of LN2 (doc 1359)
LN2 as a substrate coolant: Advantage and Disadvantage (doc 1370)
Comments on water to vacuum joints in Pixel Detector (doc 1366)
ESLI Ovalized dogleg tube panel (doc 1163)

Status: approved at the same time as TPG

The Pixel Group is committed to value engineering of their detector and will continue to use the value engineering procedures above to resolve the remaining issues as the final detector design is developed and implemented.

VALUE ENGINEERING PROPOSAL

PROPOSAL **WBS:** 1.3 **DATE: February 2004**

LEVEL 2 MANAGERS: M. Artuso, T. Skwarnicki

DESCRIPTION: Change in baseline photon detector for gas rich

ORIGINAL DESIGN: 944 HPDs

PROPOSED DESIGN: 9016 MaPMTs

ADVANTAGES : Lower cost of MaPMT system due to very unfavorable exchange rate between EU and USD. In addition this system uses conventional High Voltage system [0.6-1 KV] rather than 20KV. The higher gain makes the noise requirements in the front-end electronics easier to meet. The geometry allows the use of conventional PCBs to host the front-end hybrids.

DISADVANTAGES: The higher current draw in the MaPMT bases requires cooling.

JUSTIFICATION: The advantages summarized before lead us to the implementation of a cheaper system, that reduces the hazards involved in the design and make the requirements on the front-end electronics more manageable.

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE	HPD	944	6629	6,257,776
SUBTOTAL				

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD	MaPMT	9016	534	4,814,544
SUBTOTAL				
Net savings				
SAVINGS				**1,443,232**

PROPOSAL STATUS:

___ Pending Review _X_ Approved Via Tech Board

_X_ Approved Via Collaboration ____ Approved Via Change Control Board

___ Approved Via L2 Manager ___ Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL BTeV EMCAL Sub-Project **WBS:** 1.4 **DATE:** 11/03/2004

LEVEL 2 MANAGER: **Yuichi Kubota**

DESCRIPTION: Proposal to modify light monitoring pulser

ORIGINAL DESIGN: Laser pulser

PROPOSED DESIGN: LED pulser

ADVANTAGES: cheaper, more stable both in pulse heights and timing, low maintenance, long lifetime, ease of controlling pulse heights, not coherent (coherent light in this application causes problem because it is very sensitive to interference and lead to unstable light intensity at crystals)

DISADVANTAGES: intensity tends to be lower than laser, but recent development of high-intensity LED's, particularly in the blue region, is sufficient to use them in our application. We will need 4 pulsers. The wavelength cannot be shorter than 360 nm, but this is short enough for us.

JUSTIFICATION:
The advantages of LED provide a possibility to build cheaper, robust, more manageable EMCAL monitoring system. This means more precise control/correction of the EMCAL properties. The system consists of 4 pulsers which makes a fiber distribution simpler and cheaper

COST ESTIMATING WORKSHEET

ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE				
Laser system (Nd:YLF pump laser +		2	175,000	350,000
tunable Ti:S laser)				
10 years extended service		1	98.000	98,000
SUBTOTAL				**448,000**

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD				
LED		10	40	400
Pulser (electronics + mechanics)		4	10,500	42,000
SUBTOTAL				**42,400**
Net savings				
Indirect and Contingency				
TOTAL SAVINGS				**405,600**

PROPOSAL STATUS:

___ Pending Review
_x_ Approved Via Collaboration
_x_ Approved Via L2 Manager
_x_ Approved Via Tech Board
___ Approved Via Change Control Board
___ Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL BTeV EMCAL subproject **WBS:** 1.4 **DATE:** 11/03/2004
LEVEL 2 MANAGER: Yuichi Kubota

DESCRIPTION: Proposal to modify cell structure for mechanical support.

ORIGINAL DESIGN: Carbon-fiber structure with 400 μm thickness around all sides of the crystals.

PROPOSED DESIGN: Al-strip structure with 300 μm thick between the crystals for 2 sides, but for the other 2 sides are 1/3 Al and 2/3 air because strips are much narrower.

ADVANTAGES: 1) cheaper cell structure; 2) less crack thickness between crystals – 300 μm vs 400 μm; 3) for 2/3 length of two sides the air between the crystals rather than any material.

DISADVANTAGES: Aluminum is more dense than carbon fiber – all together slightly more energy deposit in dead material.

JUSTIFICATION: The new cell structure of the mechanical support will have less crack thickness between the crystals. The overall cost of the project is significantly reduced.

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE				
	Cell	10,000	40	400,000
SUBTOTAL				**400,000**

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD	each	1	79153	79,153
SUBTOTAL				**79,153**
Net savings				
Indirect and Contingency				
TOTAL SAVINGS				**320,847**

PROPOSAL STATUS:

___ Pending Review __ Approved Via Tech Board

_x_ Approved Via Collaboration __ Approved Via Change Control Board

_x_ Approved Via L2 Manager ___ Rejected

1.8 VALUE ENGINEERING OVERVIEW

Value engineering has been a normal practice in the development of the BTeV trigger system (WBS 1.8). Many examples of WBS 1.8 value engineering predate the practice of using detailed cost estimates to compare original designs to proposed new designs. For these design changes detailed physics simulations and simple cost-benefit analyses supported the decision making process. Examples of value engineering decisions that have been made for the trigger system include the following:

1. A 2-plane algorithm for the L1 pixel trigger vs. a 3-plane algorithm
2. An L1 algorithm that does not use "exterior x hits" vs. an algorithm that does
3. An L1 algorithm based on "inner" and "outer" track segments vs. continuous pixel-detector tracking
4. Field programmable gate arrays (FPGAs) for pattern recognition vs. fixed-point digital signal processors
5. C code for L1 pixel trigger vs. hand-optimized assembly language
6. FPGA hash sorting to reduce processing on digital signal processors vs. no sorting for track segments
7. Multiple L1 trigger "highways" vs. monolithic trigger system
8. Common hardware for L1 muon trigger vs. unique L1 muon trigger design

The methodology that was used to guide the decision making process was based on the following phases:

1. Information Phase

The information phase was dominated by the requirements for the BTeV trigger system. These requirements were developed by the subproject team after performing extensive simulations to explore the physics reach and goals of the experiment. The trigger requirements document can be found in the BTeV Document Database (#878).

2. Speculation Phase

The speculation phase entailed a baseline design that satisfied the requirements for the trigger system. The baseline design was presented to the full BTeV Collaboration, presented to physicists at conferences and in publications, and was reviewed by a technical review committee for the Fermilab PAC.

3. Analysis Phase

Value engineering was performed by comparing detailed results from simulations for proposed design changes to results obtained for the baseline design. Value engineering considerations were based on cost, available expertise, reliability, schedule risk, and the physics goals of the experiment.

4. Value Management Proposal

Value management proposals were included as changes to the trigger design only after extensive discussions of simulation results in weekly Trigger Group meetings had taken place.

5. Value Management Presentation

Simulation results provide the cornerstone for value management. These results include simulations of physics states that are vital to the experiment, trigger performance simulations, pixel noise and inefficiency simulations, data-flow simulations and queuing studies.

Presentations of results were presented at weekly Trigger Group meetings, BTeV Collaboration meetings, at conferences and in publications. The presentations are available in the BTeV Document Database. Final acceptances of design changes that deviate from the baseline design are made only after presentation to and approval by the BTeV Technical Board.

Our most recent change to the baseline design is presented as an example in the following proposal:

VALUE ENGINEERING PROPOSAL

PROPOSAL: Commodity processors and networking equipment **WBS:** 1.8

LEVEL 2 MANAGER: Erik Gottschalk

DESCRIPTION: The original design had custom hardware for two of three major subsystems in the L1 pixel trigger. For the proposed design we replace the custom hardware with commodity hardware. The original design was based on Texas Instruments digital signal processors (DSPs) to perform trigger calculations, and a custom designed switch that was used to route data to the DSPs. In the proposed design the DSPs are replaced with Apple G5 processors, and the custom switch is replaced with an Infiniband switch to route data to the G5 processors. The proposed design includes additional changes for the L1 muon trigger and Global Level 1 (GL1) trigger to match the changes made to the L1 pixel trigger.

ORIGINAL DESIGN: Custom L1 switch and custom farm processors.

PROPOSED DESIGN: Commercial networking switch and commodity farm processors.

ADVANTAGES: Use of commodity processors and networking equipment in the L1 trigger reduces cost, eliminates design effort for custom hardware, and offers a programming environment that is easier and less costly to master for software developers working on L1 trigger algorithms and L1 control and monitoring software.

DISADVANTAGES: The commodity hardware requires more power than the custom hardware, and requires additional cooling.

JUSTIFICATION: Reduced development cost, reduced labor resources, and reduced schedule risk.

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE				
L1 trigger with custom hardware	each	1	7,302K	7,302K
SUBTOTAL				**7,302K**

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD				
L1 trigger with commodity hardware	each	1	7,062K	7,062K
SUBTOTAL				**7,062K**
Net savings				240K
Indirect and Contingency				88K
TOTAL SAVINGS				**328K**

PROPOSAL STATUS:

___ Pending Review   X Approved Via Tech Board

___ Approved Via Collaboration   ___ Approved Via Change Control Board

___ Approved Via L2 Manager   ___ Rejected

1.9 VALUE ENGINEERING OVERVIEW

DESCRIPTION:

In WBS 1.9, the cost savings fall mainly under the category of "cost avoidance". The following design decisions were made at various stages of development with the goal of reducing costs.

The Pixel and non-Pixel Data Combiner designs were merged, resulting in a reduction in design labor costs. The pre-pilot Level 1 Buffer and Timing systems are now based on work done for the TeVatron IPM and BPM projects, respectively. This reduces the number of design cycles from three to two for these subprojects. Changes in packaging and implementation have reduced costs by 30% for the Level 1 Buffers. We plan extensive use of built-in test methodologies to reduce the number of dedicated test stands and test labor. Commodity computers and networking equipment are used wherever possible, and purchases of these items are delayed to maximize performance/cost. We will also rely on open source software (operating systems and databases) where possible. A disk-based data staging system will allow reuse of the Level 2/3 processors during off-peak operation. The crossover point in the cost of optical storage vs. magnetic tape is occurring now, so we will base the choice of permanent storage technology on the results of this transition. For each software subproject, we review existing implementations for reuse.

The following example details the change from a data network based on custom switching modules to one based on commercial Gigabit Ethernet. This change required a modification to the general architecture to increase the average packet size and reduce the packet rate. At the time the system was originally designed, the cost of Gigabit Ethernet was comparable to the custom switch solution, but anticipated price declines have resulted in significant savings in both material and development costs.

The new "highway" architecture has some additional cost benefits not listed here. In particular, it simplifies staging of the DAQ and Trigger systems. Since each "highway" is an independent fully functional data acquisition/trigger system, we can now measure the actual data rate requirements in the first stage of operation and adjust the number of components per highway when placing orders for the second stage.

VALUE ENGINEERING PROPOSAL

PROPOSAL: Data Network **WBS:** 1.9

LEVEL 2 MANAGER: Votava

DESCRIPTION: Use of commercial networking equipment and data "highways". Commercial networking is more efficient when processing larger data packets and lower packet rates, and the "highway" architecture provides a factor of 8 improvement in each of these parameters.

ORIGINAL DESIGN: Custom switch, single large network.

PROPOSED DESIGN: Commercial networking (Gigabit Ethernet) and 8 independent datapaths.

ADVANTAGES: Eliminates the design cost associated with special purpose network hardware. Simplifies design of other readout and trigger components.

DISADVANTAGES: Some decrease in data routing/balancing capability (not significant).

JUSTIFICATION: Reduced development cost and schedule.

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE				
custom switch modules	each	32	8K	256K
SUBTOTAL				**256K**

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD				
Gigabit Ethernet switches	each	48	600	29K
SUBTOTAL				**29K**
Net savings				227K
Indirect and Contingency				83K
TOTAL SAVINGS				**310K**

PROPOSAL STATUS:

___ Pending Review   _X_ Approved Via Tech Board

___ Approved Via Collaboration   ___ Approved Via Change Control Board

___ Approved Via L2 Manager   ___ Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL C0 IR Lattice **WBS:** 2.0 **DATE: 7/27/04**
LEVEL 2 MANAGER: Mike Church

DESCRIPTION: Proposal to modify the C0 IR lattice insertion. Full documentation is in btev-doc-3230.

ORIGINAL DES IGN: Original design produced a first parasitic beam-beam crossing separation of 3.5 beam ?'s. It utilized 2 types of X2 spools (right and left).

PROPOSED DESIGN: The proposed design produces a first parasitic beam-beam crossing separation of 6.5 beam ? 's. It utilizes 1 type of X2 spool. Magnetic elements are rearranged slightly.

ADVANTAGES : 1) Larger beam-beam separation produces a more dynamically stable lattice. 2) Reduced number of spool types reduces the number of required spare spools by 1. 3) Rearrangement of magnetic devices reduces the total cost of non-magnetic cryogenic devices.

DISADVANTAGES: None

JUSTIFICATION: The more dynamically stable lattice will yield improved luminosity lifetimes in the Tevatron, increasing BTeV integrated luminosity. The overall project cost is reduced.

COST ESTIMATING WORKSHEET (includes Project and Spares costs; includes M&S and Labor; includes G&A)

ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST (K$)	TOTAL (K$)
HTS leads	pair	14	150	2100
corrector packages	each	20	75	1500
spool assemblies	each	15	359	5385
nonmagnetic cryogenic elements	each	9	variable	1267
SUBTOTAL				**10252**

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST (K$)	TOTAL (K$)
HTS leads	pair	13	150	1950
corrector packages	each	18	75	1350
spool assemblies	each	14	359	5026
nonmagnetic cryogenic elements	each	7	variable	1196
SUBTOTAL				**9522**
Net savings				730
~~Indirect and~~ Contingency				38%
TOTAL SAVINGS				**1007**

PROPOSAL STATUS: The proposal is fully documented in btev-doc-3276 and btev-doc-3230. It has been reviewed and approved up to and including the FNAL Directorate in accordance with the BTeV Project Change Control procedures outlined in the BTeV PMP. Cost and schedule details have been fully incorporated into the C0 IR WBS. Technical details have been fully incorporated into the C0 IR TDR.

___	Pending Review	_x_	Approved Via Tech Board
___	Approved Via Collaboration	____	Approved Via Change Control Board
_x_	Approved Via L2 Manager	___	Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL Use existing HTS leads in the C0 IR **WBS:** 2.0 **DATE: 8/21/04**
LEVEL 2 MANAGER: Mike Church

DESCRIPTION: There are 7 HTS lead pairs in the FNAL/TD Special Process Spares pool. These were previously tested at 6 kA. We have recently successfully tested one of these pairs at 10 kA, therefore we deem them suitable for use in the C0 IR.

ORIGINAL DESIGN: 13 new 10 kA HTS lead pairs would be purchased from a vendor.

PROPOSED DESIGN: 6 new 10 kA HTS lead pairs will be purchased from a vendor. 7 existing lead pairs will be purchased from the FNAL/TD Special Process Spares pool at a reduced price and operated at 10 kA.

ADVANTAGES : Reduced cost. Additional float in the schedule

DISADVANTAGES: None

JUSTIFICATION: An existing 6 kA lead pair was successfully tested at 10 kA under controlled conditions equivalent to Tevatron operating conditions. Also a 6 kA lead pair previously installed in an H-spool underwent limited tests at 9.6 kA successfully. On the basis of these tests we are confident that the lead pairs previously tested at 6 kA can be operated successfully at 10 kA. This will reduce overall project cost and increase the schedule float for this item.

COST ESTIMATING WORKSHEET (includes Project and Spares costs; includes M&S and Labor; includes G&A)

ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST (K$)	TOTAL (K$)
new HTS leads	pair	13	150	1950
SUBTOTAL				**1950**

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST (K$)	TOTAL (K$)
new HTS leads	pair	6	150	900
existing HTS leads	pair	7	104	728
SUBTOTAL				**1628**
Net savings				322
~~Indirect and~~ Contingency				40%
TOTAL SAVINGS				**451**

PROPOSAL STATUS: Tests of existing HTS leads has been documented in an internal TD note. The new cost and schedule details have been fully incorporated into the C0 IR WBS. The review process is complete at the L2 Manager level.

___	Pending Review	___	Approved Via Tech Board
___	Approved Via Collaboration	___	Approved Via Change Control Board
x	Approved Via L2 Manager	___	Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL **WBS:** 3.0 **DATE:** Oct 8 to 10 2003*(See Note 1)*
LEVEL 2 MANAGER: T.Lackowski

DESCRIPTION: Use of Pond for rejecting heat vs. Air Chiller

ORIGINAL DESIGN: Air-cooled Chiller

PROPOSED DESIGN: Use Pond Water/ICW

ADVANTAGES : Lab Use in other areas / Typically good life cycle cost based on past project but typically high first cost. *(note 3)*

DISADVANTAGES: Will require additional space for strainers, heat exchangers and pumps, and high first cost

JUSTIFICATION: N/A: *Note 1 (Initial cost during Oct 10 2003 included items that were eventually deleted or removed from WBS scope, such as LCW, ECW and various back up equipment)*

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
Convert Air system rejection to water cooled	1	LOT	$702,062	
SUBTOTAL			$702,062	

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD ICW system for chiller & Free Cooling	1	LOT	$870,306	
& convert heat rejection to water cooled				
SUBTOTAL			$870,306	
Net savings			$(168,244)	
TOTAL SAVINGS (1st cost only –see note 3)			$(168,244)	

Note 3 (During the development of this ICW option, it became apparent that the space will be a major issue for the pond/ICW option. Because of this, we did not continue pursuing the life cycle cost, or any other related item, beyond the cost estimate)

PROPOSAL STATUS:

___	Pending Review	__	Approved Via Tech Board
___	Approved Via Collaboration	____	Approved Via Change Control Board
___	Approved Via L2 Manager	**_X_**	Rejected

VALUE ENGINEERING PROPOSAL

PROPOSAL **WBS:** 3.0
LEVEL 2 MANAGER: Lackowski

DESCRIPTION: Eliminate the Electronics Bridge and Replace with Bay at Stair #3

ORIGINAL DESIGN: The original design erected a two-story space spanning across the high bay directly over the rolling door leading to the Collision Hall. The space was a long inflexible space. The Electronics Bridge restrained the crane travel.

PROPOSED DESIGN: The proposed design takes advantage of the footings installed in the original construction and constructs a 25' x 25' bay off the northeast corner of the building. One story, and three story bays were examined (425 net sf per floor additional space)

ADVANTAGES : The construction of the Electronics Bridge required difficult and specialized construction. By adding the space in a standard 25' x 25' bay allows for flexibility for rack and tech space layout. The three-story space allows for expansion of the number of racks without exceeding 8kw per rack and thus not requiring specialized cooling. The proposed required stair and the existing foundations provide economies of design. Cable lengths have been studied with a very slight increase in total length of cable.

DISADVANTAGES: A three-story bay provides a minor amount of space that is at this time not programmed. The cost for the three-story bay is slightly above the original base cost but is extremely cost effective and provides a modest amount of space for expansion. A one or two story bay would be extremely difficult to expand at a later date, thus pushing towards a three-story solution.

JUSTIFICATION: The proposed space is flexible, of standard construction providing value to the government.

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE				
Electronic bridge	Lot	1	$110,234	$110,234
SUBTOTAL				

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD				
Three Story Proposal	1	Lot	$135,074	$135,074
SUBTOTAL				
Net savings				
TOTAL SAVINGS				**($24,840)**

PROPOSAL STATUS:

___	Pending Review	_X_	Approved Via Tech Board
___	Approved Via Collaboration	____	Approved Via Change Control Board
_X_	Approved Via L2 Manager	___	Rejected

FERMILAB: FESS COST ESTIMATE

Project Title: Electronic Bridge Value Engineering Study				Project No. 6-8-3	Status: CDR	Date: 9/15/04	Revision Date:
ITEM NO.		DESCRIPTION OF WORK:		QUANTITY	UNITS	UNIT COST	AMOUNT
		Electronic Bridge Base					**$110,234**
05		**METAL**					
		Electronics' Bridge	$48,250				
		Floor and wall Struct 7' x 33' x 2		450	SF	$50	$22,500
		Roof		225	SF	$10	$2,250
		Computer Floor		450	SF	$30	$13,500
		M/E		1	Lot	$10,000	$10,000
	200	**Stair Enclosure and Misc. Steel**	$23,936				
		Stair enclosure columns W8 x 31 x 29'-6" x 4		1.9	tons	$2,600	$4,940
		Wall purlins C 8 x 11.5 x 32' x 4		0.8	tons	$2,800	$2,240
		Stair Enclosure Roof Beam W8 x 21 x 48'		0.6	tons	$2,500	$1,500
		Roof Floor Angles L5x3 @t# x 32" x 2		0.3	tons	$3,000	$900
		Stair enclosure Roof Deck 8' x 16'		128	SF	$2	$256
		New Side Stair		34	Risers	$150	$5,100
		Landings 4'x 7'-6" x4		120	SF	$75	$9,000
07		**Moisture - Thermo Control**	$38,048				
		Preformed Roofing & Siding	$33,950				
		Metal Siding 2-Pcs W /insul					
		Siding for Stairway 32' x 36'		1150	SF	$29	$33,350
		Flashing and trim		60	LF	$10	$600
		Membrane Roofing	$4,098				
		Roofing 4-Ply					
		3" Insul Board and roofing @ stair 9' x 16'		144	SF	$5	$648
		Blocking and Flashing		130	LF	$15	$1,950
		Rework Existing Roof		1	Lot	$1,500	$1,500

Project Title: Electronic Bridge Value Engineering Study	Project No. 6-8-3	Status: CDR	Date: 9/15/04	Revision Date:

ITEM NO.		DESCRIPTION OF WORK:		QUANTITY	UNITS	UNIT COST	AMOUNT
		Three Story Addition Proposal					**$135,074**
03		**CONCRETE**	**$17,000**				
		Floor Deck El: 755-4	$8,500				
		8" PT Concrete Slab		10.50	CY	$800	$8,400
		Edge angles		50	LF	$2	$100
		Floor Deck El: 766-0	$8,500				
		8" PT Concrete Slab		10.5	Cy	$800	$8,400
		Edge angles		50	LF	$2	$100
04		**MASONRY**	**$5,300**				
		8" Concrete Block		500	SF	$9	$4,300
		Remove/Dispose Temp Partitions		1	Lot	$1,000	$1,000
05		**METAL**	**$37,936**				
	100	**Mezz Structural Steel**	$14,000				
		Stl. Columns W12x58 x 14 x 2		0.8	tons	$2,600	$2,080
		Girders W12 x 31 x 25' x 2		1.55	tons	$2,000	$3,100
		Beams W16 x 26 x 25' x 6		1.95	tons	$2,000	$3,900
		Beam Clips 21 X 4		16	Ea	$20	$320
		Misc. Steel		1	lot	$2,000	$2,000
		Floor Beams		1.3	tons	$2,000	$2,600
	200	**Stair Enclosure and Misc. Steel**	$23,936				
		Stair enclosure columns W8 x 31 x 29'-6" x 4		1.9	tons	$2,600	$4,940
		Wall purlins C 8 x 11.5 x 32' x 4		0.8	tons	$2,800	$2,240
		Stair Enclosure Roof Beam W8 x 21 x 48'		0.6	tons	$2,500	$1,500
		Roof Floor Angles L6x3 @t# x 32" x 2		0.3	tons	$3,000	$900
		Stair enclosure Roof Deck 8' x 16'		128	SF	$2	$256
		New Side Stair		34	Risers	$150	$5,100
		Landings 4'x 7'-6" x4		120	SF	$75	$9,000
07		**Moisture - Thermo Control**	$64,638				
		Preformed Roofing & Siding	$59,200				
		Metal Siding 2-Pcs W /insul					
		Siding for Stairway		2000	SF	$29	$58,000
		Flashing and trim		120	LF	$10	$1,200
		Membrane Roofing	$5,438				
		Roofing 4-Ply					
		3" Insul Board and roofing @ 25 x 25		625	SF	$5	$2,813
		Blocking and Flashing		75	LF	$15	$1,125
		Rework Existing Roof		1	Lot	$1,500	$1,500
10			**$10,200**				
		Additional Fire Protection	$10,200				
		El 746 Sprinkler		425	SF	$8	$3,400
		El 755 Sprinkler		425	SF	$8	$3,400
		El 766 Sprinklers		425	SF	$8	$3,400

Project Title: Electronic Bridge Value Engineering Study				Project No. 6-8-3	Status: CDR	Date: 9/15/04	Revision Date:
ITEM NO.		DESCRIPTION OF WORK:		QUANTITY	UNITS	UNIT COST	AMOUNT
		One Story Addition Proposal					**$110,803**
03		**CONCRETE**	**$8,500**				
		Floor Deck El: 755-4	$8,500				
		8" PT Concrete Slab		10.50	CY	$800	$8,400
		Edge angles		50	LF	$2	$100
04		**MASONRY**	**$5,300**				
		8" Concrete Block		500	SF	$9	$4,300
		Remove/Dispose stair sideing		1	Lot	$1,000	$1,000
05		**METAL**	**$52,636**				
	100	**Mezz Structural Steel**	$28,700				
		Stl. Columns W12x58 x 14 x 2		0.8	tons	$2,600	$2,080
		Girders W12 x 31 x 25' x 2		10.2	tons	$2,000	$20,400
		Beams W16 x 26 x 25' x 6		1.95	tons	$2,000	$3,900
		Beam Clips 21 X 4		16	Ea	$20	$320
		Misc. Steel		1	lot	$2,000	$2,000
	200	**Stair Enclosure and Misc. Steel**	$23,936				
		Stair enclosure columns W8 x 31 x 29'-6" x 4		1.9	tons	$2,600	$4,940
		Wall purlins C 8 x 11.5 x 32' x 4		0.8	tons	$2,800	$2,240
		Stair Enclosure Roof Beam W8 x 21 x 48'		0.6	tons	$2,500	$1,500
		Roof Floor Angles L5x3 @t# x 32" x 2		0.3	tons	$3,000	$900
		Stair enclosure Roof Deck 8' x 16'		128	SF	$2	$256
		New Side Stair		34	Risers	$150	$5,100
		Landings 4'x 7'-6" x4		120	SF	$75	$9,000
07		**Moisture - Thermo Control**	$40,967				
		Preformed Roofing & Siding	$34,704				
		Metal Siding 2-Pcs W /insul					
		Siding for Stairway 16' x 36'		576	SF	$29	$16,704
		Siding for building		600	SF	$29	$17,400
		Flashing and trim		60	LF	$10	$600
		Membrane Roofing	$6,263				
		Roofing 4-Ply					
		3" Insul Board and roofing @ stair 25' x 25'		625	SF	$5	$2,813
		Blocking and Flashing		130	LF	$15	$1,950
		Rework Existing Roof		1	Lot	$1,500	$1,500
10			**$3,400**				
		Fire Protection	$3,400				
		El 746 Sprinkler		425	SF	$8	$3,400

VALUE ENGINEERING PROPOSAL

PROPOSAL **WBS:** **DATE:**
LEVEL 2 MANAGER:

DESCRIPTION:

ORIGINAL DESIGN:

PROPOSED DESIGN:

ADVANTAGES :

DISADVANTAGES:

JUSTIFICATION:

COST ESTIMATING WORKSHEET
ORIGINAL DESIGN

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
DELETE				
SUBTOTAL				

PROPOSED CHANGE

ITEM	UNIT	QTY	UNIT COST ($)	TOTAL ($)
ADD				
SUBTOTAL				
Net savings				
Indirect and Contingency				
TOTAL SAVINGS				

PROPOSAL STATUS:

___ Pending Review ___ Approved Via Tech Board

___ Approved Via Collaboration ___ Approved Via Change Control Board

___ Approved Via L2 Manager ___ Rejected